- -~~29~~. (Newly Added) A semiconductor device according to claim 1, wherein said adhesive layer comprises a thermoplastic PI region having a thickness of 50 μm.- -

- -~~30~~. (Newly Added) A semiconductor device according to claim 1, wherein said stud bump is connected to said electrode via an ultrasonic weld.- -

REMARKS

This Amendment cancels claims 10-24, amends claims 2, 5 and 7-9 and adds new claims 25-30. Claims 1-9 and 25-30 are pending. Claims 1, 3 and 5-8 are independent.

Attached hereto is a marked-up version of the changes made to claim 5 by the current amendment. The attached page is captioned "**Version with markings to show changes made.**" It is noted that the amendments are made only to more particularly point out the invention for the Examiner and not for narrowing the scope of the claims or for any reason related to a statutory requirement for patentability.

The Office Action requires restriction to one of Group I (claims 1-9 and 25) and Group II (claims 10-24). During a telephone conference on March 21, 2001, Applicant provisionally elected Group I for prosecution without traverse. This Amendment confirms the election of Group I (claims 1-9 and 25) for prosecution without traverse.

I. THE CLAIMED INVENTION

Applicant's invention, as disclosed and claimed, is directed to a semiconductor device including a stud bump provided on an electrode of the semiconductor chip and an adhesive layer provided on a surface of said semiconductor chip on which the electrode is formed. The

stud bump also projects from a surface of the adhesive layer. Alternatively, the semiconductor device may include a protection resin layer on a surface of a semiconductor chip, a bump on the semiconductor chip and exposed at a surface of the protection resin layer and also including an interposer which is adhered to a surface of the protection resin layer through a cured flux and electrically connected to the bump.

Yet another embodiment of the invention is directed to a semiconductor device as described above, but which also includes a tape substrate which is adhered to the adhesive layer and connected to the back of an interposer for allowing electrical conduction.

These configurations enable reliable mounting of a high-density type semiconductor device having a small pitch equal to a bare chip on an interposer or a mounting substrate with flip chip bonding for forming and connecting metal bumps between electrodes of a semiconductor chip and leads and provides a semiconductor device at low cost by providing a simpler mounting structure, easier mounting, a reduced number of mounting steps and improved yields.

II. THE APPLIED REFERENCES

The Office Action rejects claims 1-6 and 9 under 35 U.S.C. §102(b) over applicant's admitted prior art. Applicant respectfully traverses this rejection.

Applicant's admitted prior art does not teach or suggest the features of claims 1-6 and 9 including: 1) an adhesive layer provided or formed on a surface of the semiconductor chip (claims 1-2, 4-5 and 9); and 2) an interposer adhered to a surface of a protection resin layer through a cured flux (claims 3 and 6). Rather, Fig 2 discloses a protection film 18 formed on a surface of a semiconductor chip 11. There is no teaching or suggestion in applicant's

admitted prior art that the protection film 18 is an adhesive layer as recited in claims 1-2, 4-5 and 9. While the description associated with Fig. 2 mentions that the protection film 18 is cured (page 4, line 12), the fact that the film 18 is cured does not teach or suggest an adhesive layer. To one of ordinary skill in the art, "to cure" merely means to change the properties of a resin material by chemical polycondensation or addition reactions (McGraw Hill Dictionary of Scientific and Technical Terms, Fourth Edition, 1989, page 467). The statement that the protection film 18 is cured does not teach or suggest an adhesive layer, let alone an adhesive thermoplastic resin.

Figure 3 of applicant's admitted prior art also does not teach or suggest the features of claims 1-6 and 9. Rather, Fig. 3 discloses a semiconductor device body 70 having bumps 80 being mounted on an interposer 72B using an adhesive sheet 98. Since the adhesive is provided in a sheet which is entirely separate to the semiconductor device body 70, the mounting operation requires careful alignment of the adhesive sheet 98 with the semiconductor device body 70. As explained in the specification at, for example, page 7, line 19 through page 8, line 8, the mounting method required by the separate adhesive sheet 98 requires a difficult procedure properly aligning the sheet 98 with the semiconductor device body 70. This is especially difficult when the semiconductor device is minitiarized with a fine pitch of electrodes and bumps and such minitiarization is obstructed. Additionally, the bumps are not reinforced before mounting and any load applied to these bumps may cause a faulty connection. The features of the invention of providing or forming the adhesive layer on the semiconductor chip overcomes these problems.

Lastly, applicant's admitted prior art provide no teaching or suggestion of a cured flux. Applicant respectfully requests withdrawal of this rejection.

The Office Action rejects claim 25 under 35 U.S.C. §102(e) over Jackson. Applicant respectfully traverses this rejection.

Jackson does not teach or suggest the features of claim 25 including: 1) an adhesive layer provided on a surface of the semiconductor chip; and 2) a tape substrate. Rather, Jackson discloses a semiconductor chip 115 which is only provided with solder bumps 125. Only the interposer 135 of Jackson is provided with an adhesive 130. The semiconductor chip 115 of Jackson does not have an adhesive layer provided thereon.

Additionally, the office action asserts that reference number 135 of Jackson indicates a tape substrate and that the circuit board 110 is an interposer. To the contrary, reference number 135 of Jackson indicates an interposer (see, for example, col. 5, line 54). Additionally, the circuit board 110 is not an interposer. Rather, Jackson correctly discloses an interposer as number 135. As explained in the current specification at, for example, page 2, lines 6-8, an interposer serves to electrically and mechanically connect a semiconductor chip with a substrate on which the chip is to be mounted. In the case of Jackson, the semiconductor chip 115 is to be mounted on the circuit board 110 using the interposer 135. Jackson does not teach or suggest a tape substrate. Applicant respectfully requests withdrawal of this rejection.

The Office Action rejects claim 7 under 35 U.S.C. § 103(a) over Roldan et al. in view of applicant's admitted prior art; and claim 8 under 35 U.S.C. § 103(a) over Mostafazadeh et al. in view of applicant's admitted prior art. Applicant respectfully traverses these rejections.

None of the applied references teach or suggest the features of independent claims 7 and 8 including an adhesive layer provided on a surface of a semiconductor chip. The Office Action admits that neither Roldan et al. nor Mostafazadeh et al. disclose an adhesive layer.

Rather, the Office Action asserts that Fig. 2 remedies this deficiency. To the contrary, as explained above, Fig. 2 merely discloses a protection film 18 and does not teach or suggest an adhesive layer as recited in independent claims 7 and 8. Applicant respectfully requests withdrawal of these rejections.

IV. FORMAL MATTERS AND CONCLUSION

In view of the foregoing amendments and remarks, Applicant respectfully submits that the Application is in condition for allowance. Applicant respectfully requests prompt reconsideration and allowance.

Should the Examiner believe that anything further is desirable to place the Application into condition for allowance, Applicant invites the Examiner to contact the undersigned attorney at the telephone number listed below.

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Attorney's Deposit Account No. 50-0481.

Respectfully Submitted,

Date: 8/9/02

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the claims:

Please cancel claims 10-24 without prejudice or disclaimer.

Please amend claims 2, 5 and 7-9 as follows:

2. (Amended) the semiconductor device according to claim 1, further comprising:

an interposer bonded through thermocompression bonding.

5. (Amended) A semiconductor device comprising:

a semiconductor chip;

an adhesive layer [provided] formed on a surface of said semiconductor chip on which an electrode is formed;

a bump provided on said electrode of said semiconductor chip and exposed at a surface of said adhesive layer;

a wiring pattern adhered to said surface of said adhesive layer and partially bonded to said bump; and

an insulating and covering layer for insulating and covering said wiring pattern and selectively opening to form an external connecting potion.

7. (Amended) A semiconductor apparatus comprising:

two or more semiconductor devices, each of said devices [including] comprising:

a semiconductor chip[,];

an adhesive layer provided on a surface of said semiconductor chip on which an electrode is formed[,]; and

a bump provided on said electrode of said semiconductor chip and exposed at a surface of said adhesive layer,

wherein part of a surface of one of said semiconductor devices on which said adhesive layer is provided is adhered to part or all of a surface of another one of said semiconductor devices on which said adhesive layer is provided and [they] said one and said another on of said semiconductor devices are electrically connected to each other with said bumps at the adhesion surface.

8. (Amended) A semiconductor apparatus comprising:

two or more stacked semiconductor devices, each of said devices [including] comprising:

a semiconductor chip having electrodes formed on the front and back[,];

an adhesive layer provided on the front or back of said semiconductor chip[,]; and

a bump provided on said electrode of said semiconductor chip and exposed at a surface of said adhesive layer,

wherein one of said semiconductor devices is adhered to an underlaying one of said semiconductor devices [below] through said adhesive layer and the electrodes thereof are connected to each other through said bump.

9. (Amended) The semiconductor device according to claim 1, wherein said adhesive layer [is] comprises a thermoplastic resin with adhesion.

Please add new claims 25-30 as follows:

- -25. (Newly Added) A semiconductor device according to claim 1, wherein a top of said stud bump protrudes from a lower surface of said adhesive layer.- -

- -26. (Newly Added) A semiconductor device according to claim 1, wherein said stud bump has a surface which is lower than a surface of said adhesive layer.- -

- -27. (Newly Added) A semiconductor device according to claim 1, wherein said stud bump comprises gold.- -

- -28. (Newly Added) A semiconductor device according to claim 1, wherein said adhesive layer comprises a thermosetting adhesive layer.- -

- -29. (Newly Added) A semiconductor device according to claim 1, wherein said adhesive layer comprises a thermoplastic PI region having a thickness of 50 μm.- -

- -30. (Newly Added) A semiconductor device according to claim 1, wherein said stud bump is connected to said electrode via an ultrasonic weld.- -